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# Efficient Consumer Response and Information Technology for the Food Supply Chain

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## Introduction

There is a growing interest for arrangement issues regarding supply chains, because optimization of the involved processes, products and services, results in increased efficiency and new opportunities for the actors and improves the service towards the consumers.

Efficient Consumer Response (ECR) is propagated as a way towards efficient cooperation in the supply chain, with the actors directly involved with the product: suppliers ( of seeds, fertilizers etc.), farmers, fresh food industry, retailers and consumers. Other important actors are dealing with the logistic services, marketing and finance.

Information technology facilitates a fast response towards the consumers in the shops [Baty]. In this paper research in progress about a methodology based on information system architectures is presented. This approach is applied in studies in the food supply chain and figure 1 gives an inquiringly overview.

Some important characteristics of the food supply chain that should have great impact on the information systems to be used in practice:

- Divergence of the product flow along the supply chain, for example the farmer`s product of milk is processed into hundreds of consumer goods.
- One-way flow of the products, while information flows in two directions giving feed-back about the clients opinion.
- For the quality of fresh goods, the freshness and tenability are essential and should therefore be controlled well.
- Stong variations in supply and demand as a consequence of wheater conditions and other constraining factors that influences the yield and the market of fresh food products.

## Research Methodology

In ongoing research projects we aim at finding the necessary conditions and components to be modelled for a succesfull introduction of information systems, including the inter-organizational systems in the supply chain.

A supply chain represents how businesses are linked to each other by the supply of products and services. To get a clear picture of the information system architectures of the involved businesses in the food supply chains, we elaborate an approach with reference models.

The main research questions that will be captured in more detail in this presentation are:

How can we identify the opportunities in the food supply chain to reduce cost and improve the response to the consumers ?

What are essential elements for structuring the information exchange between the businesses in the food supply chain ?

What are the characteristics of information systems in the food supply chains, that enables more efficient response to the consumers ?

## **Information System Architectures**

A framework of information system architectures, adapted from [Sowa], is constructed. Our framework has three dimensions.

The first dimension represents the perspectives of the distinguished interest groups for inter-organizational systems in the supply chain: policy makers and coordinators at the chain level, the owners of the businesses, system designers, technical people and the end-users.

The resulting architectures of these perspectives, including the chain architecture, are represented in figure 2. The distinguished interactions between these architectures are depicted by the dashed lines.

The second dimension indicates which aspects may be considered in an information system study:

- Purpose and objectives to be formulated.
- The network describes the relevant locations and sites.
- The data aspect deals with the information needs.
- Function refers to how business processes are conducted and represents the task refinements.
- Authority and responsibilities are defined for participants.
- Time representation is incorporated in the dynamics.

The next table shows an example of linking the dynamic and the process aspect by showing the events that generates orders.

In business and information engineering projects, defining parts of the food supply chain, we select aspects of the second dimension. The approach needs to support decomposition as well as integration. Therefore we use modelling techniques in a metamodeling approach, where the resulting components of these techniques are adjusted, balanced and checked. These are essential features of engineering applied methods [Meijs].

The third dimension refers to the level of genericity. Especially the aspects data, process and dynamics often are defined in a stable manner for a given line of business.

It is argued that for the (re)design of information systems, adjustment of available reference models accelerates the understanding, the setting of priorities and the progress of system development. Filling up reference models with present-day data enables simulation.

Benchmarks of business processes indicate the performance of internal and external key elements. It offers a starting point for integration of systems between suppliers and their clients.

Reference models focussing on inter-organizational systems may address interest groups of the first dimension and focussing on some aspects of the second dimension.

- Dynamical models incorporate events that trigger several processes in businesses, product and customer life cycles that refer to several businesses.

- Process model crossing the boundaries of the businesses.

- Chain wide data models, focussing on cooperating networks in the supply chain require external integration of business data models.

This requires an adjustment of the semantic and pragmatic concepts, which are applied by the involved businesses.

Constraints complete models at the right aspect and perspective. For a single business the rules in force may be defined more precise and strict respectively in the business, information and system architecture. For example, for the naming of entities several synonyms or homonyms may exist in common parlance, and have to be detected in the information systems.

In the part of the chain wide data model represented in figure 3, the double-headed arrow along the roles of the retailer and the chain stores implies a one-to-many relationship between these two entities.

Identification of articles in the supply chain requires unique identification codes.

## **Towards Efficient Interorganizational Systems**

Strategic information systems support the competitive strategy of businesses [Ciborra]. Some interesting developments in the food industry are forms of cooperation like co-designership and co-makership, value contracts between chain participants, giving mutual insight in inventory levels.

Important steps in the favoured approach for starting up the streamlining of the inter-organizational systems facilitating ECR, are:

Analyse the current position and status of information system architectures of the involved businesses.

The resulting benchmark indicates the threats and opportunities.

Select the ECR concepts that need to be implemented in the supply chain:

- Automated store ordering might be implemented for a single chain store by augmentation of the following algorithm:

For article(i),  $i = 1$  to  $N$  do

if chain store (y) + ordered(y) < minimum (stock)

then order (article(i))

- Continuous replenishment is focussing on reducing the stock quantity's and increasing the number of deliveries per week

- Cross docking could be represented in figure 3 by the constraint ..., represented by an arrow along the roles of the producer and the warehouse.

- Integrated suppliers

- Reliable operations

- Synchronized production

### **Identify enabling technology.**

- Automatic identification and data collection systems are important in many areas of the food supply chain. The use of radio frequency tags provides a major breakthrough in this field. The farmer needs to identify his animals for tracking feeding patterns and for inventory.

Real-time production management systems and connected sensors collect the data about the food processing in the industry and during logistic services. Smartcards arise in the chain store.

- Communication networks facilitate the distribution of data via Electronic Data Interchange (EDI), Internet and other datacommunication systems.

- Analytical processing concepts and techniques are necessary to process the raw data. For the analysis of historical data collected in datawarehouses, data mining techniques detect causal relationships.

Determine the extensions and reengineering of information systems that are necessary for the implementation of the selected ECR concepts.

Decision support systems and executive information systems are needed to gather on-line management information.

Performance indicators are defined to measure e.g. cost reduction, promotion optimization, the number of successful product introductions or assortments optimization.

## **Conclusions and Discussion**

A case study in the food supply chain reflects the modelling concepts and the dynamics with regard to products and production processes.

Conclusion and discussion items refer to:

- the way reference models decrease complexity and cost of the requirement engineering studies.

- the redesign of business processes in the supply chain and the modelling of exclusive entities for tracking and tracing objectives.

- the visualisation of the advantages and profits and how to decide upon the sharing of profits to be gained by the introduction of ECR concepts ?

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